# DEVICE FOR ISOMETRIC/DYNAMIC EXERCISE/TRAINING/TESTING

The present invention relates to an isometric/dynamic exercising apparatus of the kind defined in the preamble of Claim 1.

The inventive exercising apparatus is of the general kind disclosed in US-A 882,181. The invention is thus based on an isometric/dynamic exercising apparatus of the kind that includes a harness that has two straps each of which extends over a respective shoulder of the user, wherein the harness is connected to a supportive surface against which the user places his/her feet, by means of a connecting device coupled to the harness. Connected to the apparatus is a device for measuring the power exerted by the user in moving the harness away from the supportive surface, and wherein the apparatus also includes means for adjusting the distance between the supportive surface and the part of the harness acting on the wearer´s shoulders.

Both the leg tensors and the back tensors are involved when the user straightens himself/herself.

I have now found that an exercising apparatus of this kind is well suited for heavy isometric/dynamic muscle exercises, both in respect of healthy and sick individuals.

The earlier known apparatus suffers a number of drawbacks which limit the usefulness of the apparatus and its user comfort.

Consequently, an object of the present invention is to provide an apparatus of the aforesaid kind that has been further developed so as to avoid or reduce these drawbacks.

This object is achieved with an apparatus according to the following Claim 1.

Further embodiments of the inventive apparatus are defined in the following dependent Claims.

The inventive exercising apparatus is thus portable and can be used by patients who are confined to their beds or are bed-ridden and in need of muscle exercising and of exercising the heart and circulatory system, and to counteract the occurrence of deep venous thrombosis. As a result of the design of the foot plate and the locations of the points at which the harness is connected to the plate, the user is afforded a stable working attitude when subjecting the apparatus to load.

In one embodiment of the invention, the apparatus is essentially non-stretchable and serves for isometric exercising purposes or for subjecting the user to load, wherein the spring device is set to enable the back muscles and leg muscles to be stretched to a maximum without yielding.

In accordance with another embodiment of the invention, the apparatus has connected thereto elastically flexible spring devices which enable the apparatus to be used in the performance of dynamic exercises, even by persons that are confined to their beds or are bedridden. The load can be controlled by evaluating the maximum force or power exerted by the user on the apparatus. The user can then exert a force which suitably constitutes a chosen proportion of the maximum force over a chosen time period. The inventive apparatus may include a measuring device that is coupled in the force flow path of the apparatus for measuring power and/or work exerted by the user between the shoulders and feet.

When using the inventive apparatus, the systolic and diastolic blood pressure and the heart rate of the user will increase, both with isometric and dynamic muscle exercises. The so-called double product, which is the systolic blood pressure multiplied by the heart rate and which is abbreviated to RPP (Rate Pressure Product), constitutes a measurement of the oxygen consumption of the heart, i.e. the load to which the heart is subjected. Any load on the muscles will thus result in a load on the heart and on the circulatory system.

In this respect, the dynamic load can be used to

- investigate the heart and the circulation and also the leg and back tensors of healthy and sick individuals, for instance patients who are confined to their beds or are bed-ridden;
- investigate the function of the heart, for instance with simultaneous echocardiography registering or isotope registering techniques during an ongoing isometric or dynamic load, an example of which is investigating patients with exercise-induced myocardial ischemia (impaired blood flow to the working heart muscle under load);
- investigate the systolic and diastolic blood pressure reaction by measuring blood pressure in conjunction with dynamic or isometric exercise of the muscles;
- evaluate and monitor patients with high blood pressure, where one example is evaluating the result of treatment after introducing medical blood pressure treatment; and to
- exercise regularly with the inventive isometric/dynamic exercising apparatus with the intention of counteracting the occurrence of venous thrombosis (clots in the veins in the legs and in the pelvis) in connection with long-term bed confinements, where bed confinement after having undergone a major operation is one example.

By enabling the flexible spring device or devices to be readily exchanged, the apparatus can be readily adjusted for use in both a dynamic and in an isometric exercising mode. For instance, a patient whose muscles are very weak may begin an exercise period with solely isometric training, and then later proceed to dynamic exercises. Conventional stress-echocardiography with pharmacological agents (e.g. Dobutamin®) must often be interrupted because of adverse side effects, such as headaches, anxiety, agitation, nausea, dyspnoea, arrhythmia and a drop in blood pressure. The inventive apparatus can be used as an isometric or dynamic exercising appliance as an alternative to pharmacological agents in conjunction with stress-echocardiography.

The spring device may include a spring arrangement that is connected to the front side and/or the rear side of the apparatus. When a spring arrangement is provided both on the front side and on the rear side of the apparatus and said spring arrangements are mutually identical, the dynamic load will be distributed essentially equally to the front side and the rear side of the apparatus. When a spring arrangement is connected solely to the front side or to the rear side of the apparatus (or when spring arrangements having mutually different spring characteristics are connected to the front side and the rear side of the apparatus), there is generated a load component that introduces a torque in the symmetry plane of the user, this torque forming a part of the dynamic load to which the user is subjected. Thus, such dynamic load components can be introduced to correspondingly exercise those muscle groups that are influenced hereby, with subsequent loading and exercising of the heart and the circulatory system.

The invention will now be described in more detail with reference to an exemplifying embodiment thereof and also with reference to the accompanying drawings.

Fig. 1 is a schematic illustration of the inventive apparatus from the rear.

Fig. 2 is a schematic illustration of the apparatus from the front.

Fig. 3 is a cross-sectional view taken on the line III-III in Fig. 1.

The apparatus illustrated in Figs. 1-3 includes a bottom plate 1 that has four attachment points 11-14 (Fig. 3) which define a surface area in whose central part the user's feet 20 can be placed on either side of a line 30 which represents the intersection between the plate 1 and the symmetry plane of the user 2.

As will be seen from Fig. 1, straps 40, 41 are connected to the attachment points 13 and 14 respectively and also to a fastener element 42 positioned in the symmetry plane 30 of the user 2. A strap-part 43 extends upwardly from the fastener element 42 to an upper strap fastener 44 in the form of a ring. A harness 50 extends from the fastener ring up over the user's shoulders 22. The harness 50 may comprise two straps 51, 52, each extending over a respective shoulder 22 and being connected to the fastener 44. Load distributing pads 60 may be fitted to the straps 62, such as to be movable along said straps and function to distribute the load from the straps 51, 52 to the upper side of the user's shoulders.

It will also be seen from Fig. 1 that the strap-part 43 includes between the attachment devices 42 and 44 a buckle 431 which enables the length of the strap-part 43 between the attachment devices 42, 44 to be adjusted.

As will be from Fig. 2, the harness straps 51, 52 are fastened to an attachment device 56 in the symmetry plane 30

on the front side of the user. The attachment device 56 is connected to a lower attachment device 57 by means of a load transmitting device 70 (a strap) connected to a lower attachment device 57, which is also located in the symmetry plane 30. A pair of straps 58, 59 are connected to the attachment device 57 and extend down to the attachment points 12, 11 on the plate 1.

The strap-part 43 is adjusted to a length at which the user is prevented from standing fully upright or lying in completely erected position between the plate 1 and the load distributing pads 60.

The load transferring device 70 includes a load sensing cell 71 which indicates the load exerted by the user between the plate 1 and the load distributing pads 22 when the user straightens his/her body and legs. The load sensor 71 may conveniently also include a display 72 that can be placed in the user's line of view. A clock may also be provided adjacent the display 72.

In preparation for a stress-echocardiography for instance, a doctor may instruct the user to perform a suitable isometric or dynamic muscle exercise with a predetermined load, this load being read on the display 72. The user is then instructed to maintain a given load in the apparatus over a chosen time period. The user sees on the display device 72, either directly or indirectly, that he is exercising at the instructed load, and may also possibly see the time remaining to the end of the exercise period.

As will be seen from Fig. 3, the plate 1 is generally symmetrical in relation to the intersection line between the plate 1 and the plane 30. It will also be seen that the rear edge 16 of the plate 1 has a convex contour which may be comprised of mutually adjacent straight contour-parts each

defining a stable pivot position for the foot plate in a bed when applied to a patient in his/her bed.

It will also be seen that the plate 1 may have straight, parallel side-edges 17, 18 that are parallel with the plate symmetry line. A patient lying on his/her side in bed with the inventive apparatus in place will be stabilized by one side-edge of the plate 1 lying stably against the bed surface.

The front edge 19 of the plate 1 may be perpendicular to the plate symmetry line or curved in a manner corresponding to the rear edge 16. The skilled person will also realize that the side-edges 17, 18 may also be curved in a manner corresponding to the rear edge 16.

It will also be understood that the force or power transmission device 70 between the attachment devices 56 and 57 may include a strap-part of adjustable length. Furthermore, the harness straps 51 and 52 or the straps 40, 41, 58, 59 may, of course, be provided with conventional means for adjusting the length of said straps if so desired.

It will also be understood that the straps 58, 59 and 40, 41 may be mutually connected and pass over respective attachment devices 42, 57 in the form of simple rings. The ends of the straps 51 and 52 may also be joined together so as to be able to run through ring-like attachment devices 44, 56.

In the case of the illustrated embodiment of the apparatus, which enables dynamic muscle training exercises to be performed, there are connected in the power flow direction of the apparatus spring devices which enable the harness to be extended elastically at a force capable of being exerted by the user, for instance so that the user is able to strech to an essentially erect position in the apparatus, with his/her

back and legs straight. Two such spring devices will preferably be connected analogously, one on the front side of the harness, suitably in the strap 70, and one on the rear side of the harness, suitably in the strap 43. In the case of this embodiment, the load sensor 71 and the display 72 belonging thereto are not absolutely necessary.

The spring device 80, 80 may comprise one or more spring arrangements 80 that can preferably be adjusted with respect to their spring characteristics. A spring arrangement may, for instance, be provided in the strap 70 on the front side of the apparatus and/or in the strap 43 on the rear side of said apparatus. In one simple embodiment, the spring arrangement may consist of a rubber-elastic strap which is given different spring characteristics by adjusting the strap to different effective lengths.

Naturally, the spring arrangements 80 may be fitted at other places in the apparatus and may, for instance, be included between the straps 40, 41 and the plate 1 and/or between the straps 58, 59 and the plate 1.

As an alternative to adjusting the spring arrangements 80, said spring arrangements may be replaced with other spring arrangements that have another spring characteristic. The actual apparatus, for instance the plate or the harness, may, of course, be elastically flexible to enable dynamic exercises to be performed on the apparatus.

When the user straightens his/her body in the harness, he/she performs a defined work. The power and work exercised by the user can be determined for different purposes, by repeating this work at a given frequency over a given period of time.

The frequency is controlled with an adjustable metronome/ tachymeter and the time can be read from a clock, wherewith

the apparatus may include both a tachymeter and a clock and possibly also calculating devices.

It will also be understood that the apparatus may include non-stretchable straps or the like that can be connected-up in the apparatus instead of said spring devices or parallel with said spring devices, so as to facilitate conversion of the apparatus between its dynamic and isometric exercising modes. Alternatively, strap-ends that are detachably connected to an opposing end of a spring device may be connectable to each other after having disconnected the spring device, so as to form an essentially non-stretchable harness that can be used for isometric exercising.

Thus, the apparatus illustrated in Figs. 1-3 for dynamic exercising can be readily converted to an apparatus for isometric exercising, by disconnecting the spring device 80 so that the harness/apparatus cannot be stretched but can be adjusted to a size suitable for isometric exercising.